Non-intrusive Hazardous Pilot Cognitive State Assessment via Semi-Supervised Deep Learning: CSA-Deep, Phase I

Completed Technology Project (2012 - 2012)

Project Introduction

In aviation history, many crew-related errors are caused by crew members being in hazardous cognitive states, such as overstress, disengagement, high fatigue, and ineffective crew coordination. To improve aviation safety, it is critical to monitor and predict hazardous cognitive states of crew members in a non-intrusive manner for designing mitigation strategies. In Next Generation Air Transportation System (NextGen) flight deck, emerging technologies will enable a transition from ground based navigation infrastructure to satellite based navigation and some control relating to separation of traffic will be delegated to the cockpit from Air Traffic Control (ATC). While the NextGen system will bring tremendous advantages in operational efficiency, the responsibilities of the pilot are expected to dramatically increase, which makes the hazardous cognitive state assessment even more critical. To address the above challenges, Intelligent Automation, Inc. (IAI), along with the Operator Performance Lab (OPL) in University of Iowa and Old Dominion University, proposes a real-time hazardous pilot Cognitive State Assessment system, called CSA-Deep, in all phases of flight for Integrated Crew-System Interaction (ICSI). The key innovation of the proposed research is the modeling and adaptive updating of hazardous cognitive states using a large amount of unlabeled data through semi-supervised deep learning.

Primary U.S. Work Locations and Key Partners
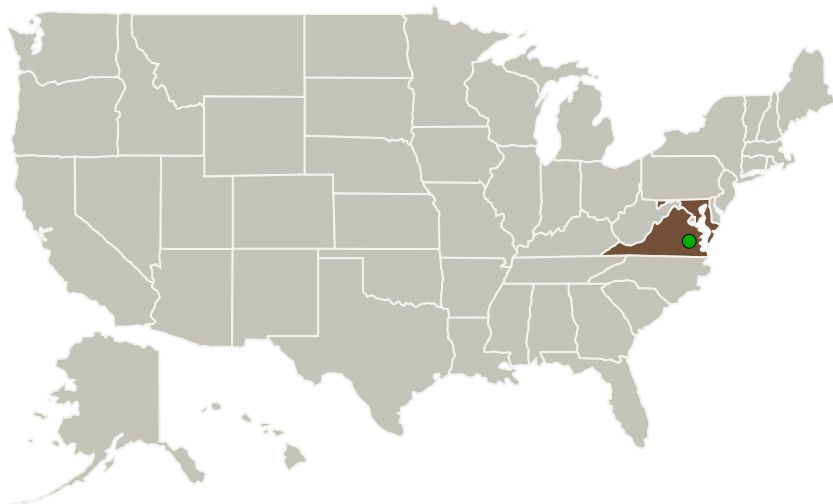
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Table of Contents

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Organizations Performing Work	Role	Type	Location
Intelligent Automation, Inc.	Lead Organization	Industry	Rockville, Maryland
🟢Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations	
Maryland	Virginia

Project Transitions

▶ **February 2012:** Project Start

✔ **August 2012:** Closed out

   Closeout Documentation:
   - Final Summary Chart*(https://techport.nasa.gov/file/138364)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Intelligent Automation, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management
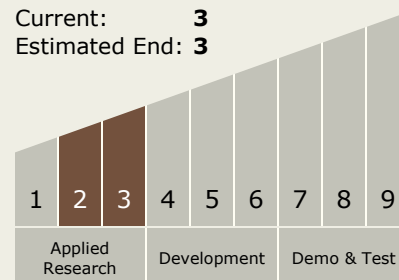
Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Guangfan Zhang

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**

1	2	3	4	5	6	7	8	9
	Applied Research			Development			Demo & Test	

Technology Areas

Primary:

- TX05 Communications, Navigation, and Orbital Debris Tracking and Characterization Systems
  └ TX05.5 Revolutionary Communications Technologies
    └ TX05.5.1 Cognitive Networking

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System